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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

A proposal for studies of the water resources of the
Mescalero Apache Indian Reservation, Otero County, New Mexico

Open-File Report 77-758

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Prepared by the Water Resources Division, U.S. Geological Survey
(at the request of the Mescalero Apache Indian Tribe and the
U.S. Bureau of Indian Affairs)

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Mescalero Apache Indian Reservation, Otero County, New Mexico
By the U.S. Geological Survey, Water Resources Division,
Albuquerque, New Mexico, District Office

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Not reviewed for conformance with Geological Survey
editorial standards and usage of geologic names

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Albuquerque, New Mexico

October 1977

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A proposal for studies of the water resources of the
Mescalero Apache Indian Reservation, Otero County, New Mexico

Request for study of water resources

On June 20, 1974 the Mescalero Apache Tribe and the U.S. Bureau of Indian Affairs requested that the Geological Survey prepare a proposal for a study of the surface- and ground-water resources of the Mescalero Indian Reservation. The reservation includes about 740 square miles of the Sacramento Mountains in northeast Otero County, New Mexico (see fig. 1).

The Tribe and the B.I.A. specifically requested that the surface-water yields of the drainage areas on the reservation to the Rio Ruidoso and the Rio Hondo be determined. These areas are on the north side of the reservation (fig. 2), and the determination is to be made within two years. Existing surface-water data are probably adequate to do this, particularly in the Ruidoso drainage basin. Studies of the ground-water resources can probably be completed in the first two years also.

As a secondary part of the study, estimates of surface-water yields from the Three Rivers, Rinconada Creek, Rio Tularosa, Rio Penasco, and Rio Felix drainages (fig. 2) are to be made after a five-year period of basic data collection. With the exception of the Rio Tularosa drainage basin, very few surface-water data have been collected in these drainage basins.

Purpose of request

Surface and ground water in the eastern three-fourths of the reservation (Ruidoso, Hondo, Felix, and Penasco drainages of figure 2) moves eastward from the Sacramento crest into the Hondo, Penasco, and Roswell underground water basins (fig. 3). The remaining part of the reservation (Three Rivers, Rinconada, and Tularosa drainages of figure 2) drains westward into the Tularosa basin. An increase of water use in the surrounding basins would probably make less surface water available for use on the reservation, as well as, increase the rate of ground water movement away from the reservation. On the other hand, increased water use on the reservation would probably diminish the water supplies in the neighboring areas. Because of this situation the Tribe wants to establish firm water-right priorities that will guarantee supplies of water for its future growth and development.

To help accomplish this purpose, the Tribe and the B.I.A. believe that accurate and reliable data describing the water resources of the reservation are needed. The best possible determinations of surface runoff and underground water in storage are desired.

Estimates of surface-water yields to the Ruidoso and Hondo drainages from the reservation and of the ground water in storage would be desirable to have in two years for legal reasons regarding water rights. Additional studies that entail the gathering of surface-water data in the other drainage basins which would take five years will be useful for management purposes, as well as, water-right declarations.

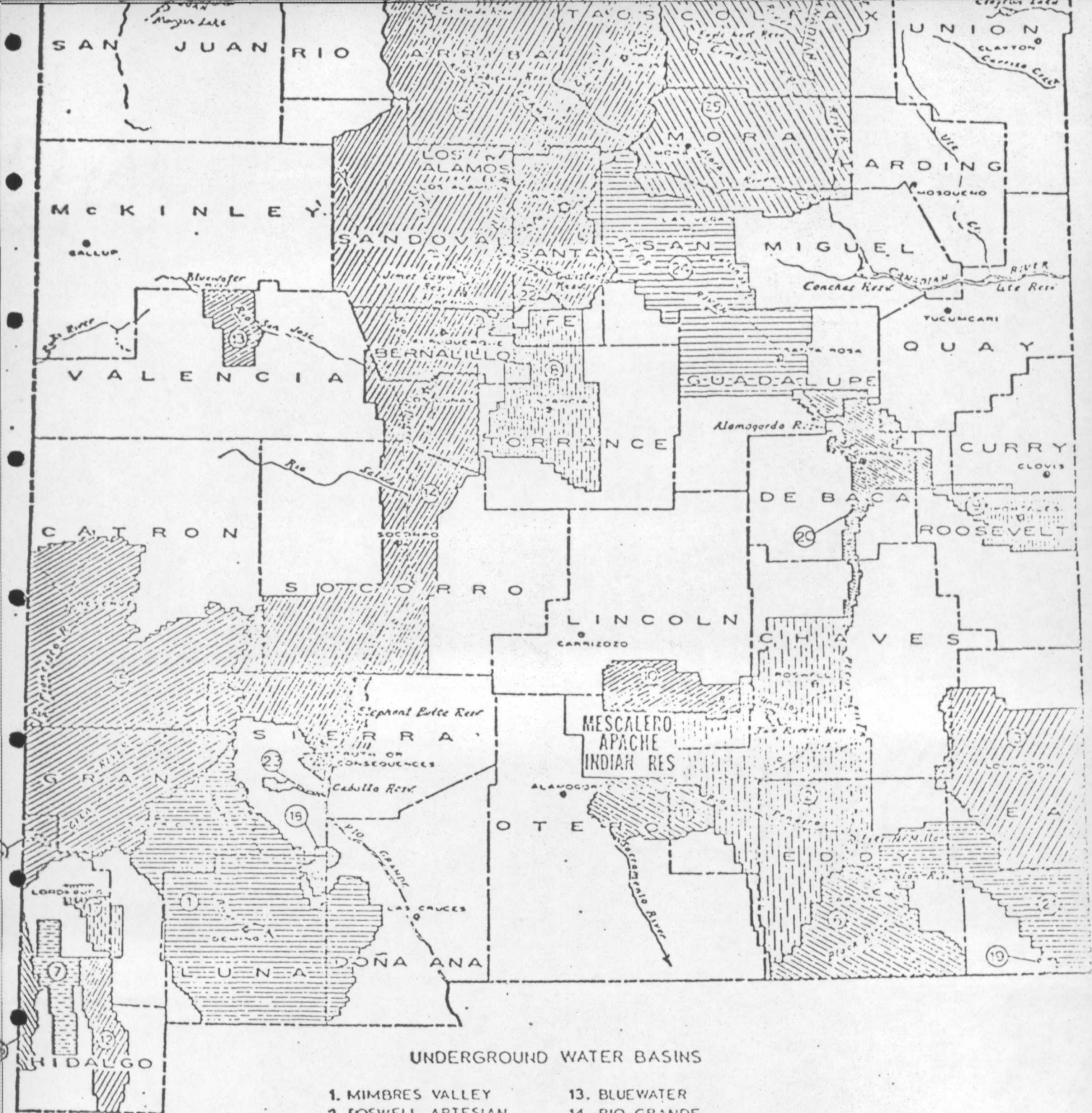


Figure 3.--Map showing relation of Mescalero Apache Indian Reservation
In relation to declared water basin in New Mexico.

The Mescalero Apache Tribe prefers that all data gathered during the investigation and the forthcoming analyses, conclusions, and possible recommendations remain confidential in nature. As a matter of long-standing policy the Geological Survey generally open-files the basic data that it collects and the reports that it prepares.

Previous Investigations

The few previously published hydrologic reports on or near the Mescalero Apache Indian Reservation were prepared by the Geological Survey. Considerable geologic work has been done by various organizations. Many of these reports are listed in Kelley's resume of the Pecos Country (1971), which includes a large amount of geologic information on the Sacramento Mountains.

The report by Maurant (1963) on the Rio Hondo drainage basin includes a part of the Mescalero Apache Indian Reservation but contains very little information on the reservation's water resources. Haven and Haynes (1963) prepared a report on the damsite possibilities near the confluence of Carrizo and Cienegita Creeks. Considerable surface- and ground-water data are in this report. Hood and Herrick (1965) describe the surface- and ground-water conditions in part of the Three Rivers drainage basin which includes about ten square miles in the northwest corner of the reservation. The report by Sloan and Garber (1971) covers the entire reservation, and is a general study of the ground-water hydrology.

Miscellaneous surface-water measurements have been made on or near the Reservation by the Geological Survey for a number of years. Continuous gaging stations have been maintained by the Survey outside of, but fairly near, the Reservation at intervals of time in the past. These gaging stations and the types and lengths of record collected at each site are listed below. The Geological Survey (1930-60, 1961-72) has published all of these data.

Surface-water measurements on or near the
Mescalero Apache Indian Reservation

Rio Ruidoso

<u>Gaging Station Number</u>	<u>Name</u>	<u>Type</u>	<u>Period</u>
08386500	Rio Ruidoso near Ruidoso	Low-Flow Partial Record	1953-Date
08386600	Carrizo Creek at Ruidoso	do	1953-Date
08387000	Rio Ruidoso at Hollywood	continuous	1953-Date
08387600	Eagle Crk blw South Fork nr Alto	do	1969-Date
08387800	Eagle Crk near Alto	do	1969-Date
--	Carrizo Creek at Boundary	Misc. meas.	1961-66

Rio Hondo

08388000	Rio Ruidoso at Hondo	Continuous	1930-55
08389500	Rio Bonito at Hondo	do	1930-55
08390100	Rio Hondo at Picacho	do	1956-62

Rio Penasco

08397600	Rio Penasco near Dunken	Continuous	1956-62
--	Silver Springs Canyon at flume	Misc. meas.	1958-69

Rio Tularosa

08481500	Rio Tularosa near Bent	Continuous	1947-Date
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Three Rivers

08480600	Three Rivers near Three Rivers	Continuous	1956-58
08480700	Indian Creek near Three Rivers	do	1956-58
08480800	Indian Creek Flume near Three Rivers	do	1956-58
08480900	Indian Creek at mouth near Three Rivers	do	1956-58

The Mescalero Apache Tribe has also maintained nine non-recording stream-gaging stations and a number of precipitation stations on the Reservation since 1941. Weather stations at Ruidoso, Mescalero, and Whitetail have been operated by the U.S. Department of Commerce for many years. (See figure 3.)

In general, existing hydrologic data are not sufficient in number, density, and character to adequately define the water resources of the Reservation. Fairly good estimates of the surface-water yields, however, can be made from the existing data of the Ruidoso and Hondo drainage areas.

Need for additional data

Past studies are not detailed enough to adequately define the hydrologic conditions of much of the study area. Although fairly good estimates of surface-water runoff from the Ruidoso, Hondo, and Tularosa drainages (fig. 2) can be made with the present data, forecasts of yields from the other drainage basins are not yet possible. Records from additional continuous gaging stations are needed for at least five years before estimates of runoff on all parts of the Reservation are feasible. It should be emphasized that even with five years of data only estimates instead of reliable values can be obtained.

Sloan and Garber (1971) state that the Yeso Formation is probably the best source of ground water on the Reservation. Virtually nothing is known of the ability of the formation to store and transmit water. In fact, the lithology and stratigraphy of the formation are still largely unknown. Electrical logging of key wells, aquifer pumping tests, and some deep test wells, as well as, an analysis of all available well data are greatly needed in order to define the ground-water resources. The stratigraphy and structure of the rocks in the vicinities of the main springs should be examined so that the sources can be determined.

Quality-of-water and sediment stations in each drainage basin would give information on changes in the quality of the surface water and the amount of sediment that is being eroded and carried off the Reservation. Sediment-load data are useful in planning the life of reservoirs.

All of the data collections mentioned above would be helpful in defining the water resources and, in turn, establishing firm water-right priorities. In addition, these data would facilitate good management of water for future use.

Anticipated results of additional studies

The benefits that can be expected from additional studies of the water resources on the Mescalero Apache Indian Reservation are outlined below:

Surface water

1. Estimates of long-term mean-annual flow at the Reservation boundary for major drainage basins.
2. Estimates of low-and peak-flow characteristics at selected sites.
3. Location of areas where surface and ground water are closely related.
4. Chemical quality of surface water and establishment of sampling network to detect changes in quality.
5. Estimates of sediment transportation from the Reservation by surface water.

Ground water

1. Identification and distribution of the important water-bearing formations.
2. Estimates of ground water in storage and the ability of aquifers to transmit water.
3. Identification of spring sources and their relation to the ground-water regime.
4. Discharge of ground water by wells and springs.
5. Chemical quality of ground water, its relation to source, and establishment of sampling network to detect changes in quality.
6. Depth-to-water and establishment of observation well network to determine future changes in the depth-to-water.

In addition to the items listed above, overall estimates of water moving into and out of the Reservation can probably be made; and estimates of the effects of increased usage, both inside and outside of the Reservation, will be possible. Some type of a mathematical model of the hydrologic system will probably be required to determine these effects.

Outline of study

Much of the field and office work will be quantitative in nature. In general, the surface water phase will consist of data collection, analyses of existing and collected data, and investigation of the transferability of data to ungaged sites.

Estimates of mean-annual flows can be provided by measuring flow at selected sites and then extending this data to ungaged sites on the basis of climatic or topographic characteristics of the basin. It has been shown in previous studies that the size and geometry of alluvial stream channels are related to the amount of water carried by the channel (Hedman, 1970; Hedman and Others, 1972; Moore, 1968). This technique can also be used to transfer data to ungaged sites on the reservation.

Estimates of low-flow characteristics of these streams will require periodic observations of flow. This can be accomplished by utilizing the same data as that used to determine mean-annual flows.

Flood-flow characteristics of these streams can be estimated with existing data.

The ground-water phase will include electrical logging of wells, aquifer pumping tests, and the drilling of three deep test holes.

A detailed outline of the investigation follows:

Surface water

1. Establish gaging station network, which will consist of seven new continuous streamflow stations in addition to the existing

stations. Tentative location of proposed streamflow stations are shown on figure 4.

2. Establish six sites at which monthly measurements of discharge will be made. These data can be correlated with the records from the gaged sites to provide estimates of flow at these sites.
3. In areas that drain to the Rio Ruidoso and Rio Hondo, collect channel geometry parameters at gaged and ungaged sites.
4. At the end of two years, analyze the data to determine flow characteristics at gaged sites, including downstream or nearby gages.
5. Extend these data to ungaged sites and prepare report.
6. Collect channel parameters at gaged and ungaged sites within the remaining five basins.
7. At the end of five years analyze data in the remaining five basins. Also reanalyze data from Rio Ruidoso and Rio Hondo areas to see if there are any significant changes in estimates resulting from the additional data which will be collected.
8. Prepare final report.

Ground water

1. Analyze all existing well data to determine the character of producing zones. This includes drillers' logs and the examination of well cuttings.
2. Run electric logs on about 15 existing wells to determine the continuity and thickness of the producing zones.

3. Conduct aquifer tests to determine yields and aquifer characteristics at a number of strategic sites. These to be determined after 1 and 2 are completed. Five-to-ten tests might be needed.
4. Drill three deep test holes to determine thickness and character of sedimentary rocks overlying the Precambrian basement rock. These holes will be about 2,000 feet deep. Tentative locations of proposed test hole sites are shown on figure 4.
5. Study the stratigraphy and structure of the rock at the larger springs to determine spring source and relation to overall ground-water regime.
6. Measure the yields of wells and springs to determine the ground-water discharge from these sources.
7. Set up an observation well network to monitor water-level changes for several years.
8. Collect 100 water samples from wells and springs for quality analysis.
9. Complete all field work by the middle of the second year.

Simulate the hydrologic system with a small mathematical model to determine effects at Reservation boundary from increased water usage both inside and outside of the Reservation.
10. Write and complete report by the middle of the third year. This report will probably be part of step 5 under surface water phase.

Manpower needs

From U.S. Geological Survey

Man-months

1 Surface-water technician, Grade GS-6, field	60
1 Surface-water professional, Grade GS-12, analysis	8
1 Ground-water professional, Grade GS-11, field and analysis	24
1 Mathematician, Grade GS-11, analysis	2
3 Surface-water technicians, 1 Grade GS-7, 2-GS-3, Gage construction and QW-sediment gage installation	6
2 Ground-water technicians, 1 GS-11, 1-GS-7, Elec. logging	<u>3</u>
Total	103

Contract labor

Equipment and labor to
pull and reinstall tubing
on 15 wells

--

Equipment and labor to
drill and test 3 deep
exploratory wells

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From Mescalero Apache Tribe

One or two men to make routine
water-level and precipitation
readings, maintain equipment,
collect samples, etc..

Cost of study

	Cost per year				
	1	2	3	4	5
Stream-gage construction (6 continuous gages)	18,000	0	0	0	0
Operation of 7 continuous gages	17,500	17,500	17,500	17,500	17,500
Operation of 6 measuring sites	3,000	3,000	3,000	3,000	3,000
Surface-water data analysis and report prep.	4,000	8,000	0	0	4,000
Install and operate 7 Q.W. and sediment stations	11,200	11,200	11,200	11,200	11,200
Electric log 15 wells	7,500	0	0	0	0
Drill 3 test holes	90,000	0	0	0	0
Ground-water field work, data analysis, model, and report prep.	26,000	28,000	18,000	0	0
QW samples from 100 wells and springs	4,000	4,000	0	0	0
Review and administrative costs	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>10,000</u>
	\$186,200	\$76,700	\$54,700	\$36,700	\$45,700

Total \$400,000

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A PROPOSAL FOR STUDIES OF THE WATER
RESOURCES OF THE MESCALERO APACHE INDIAN
RESERVATION, OTERO COUNTY, NEW MEXICO

Figure 1.--Map showing location of Mescalero Apache Indian
Reservation and pertinent existing and former
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boundary.

2.--Map of the Mescalero Apache Indian Reservation
showing locations of precipitation stations
(Department of the Commerce and Tribe), Tribe
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4.--Map of the Mescalero Apache Indian Reservation
showing locations of tentative surface-water
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